ECONOMIC VALUATION OF MOIBEN RIVER POLLUTION AND IMPROVED DOMESTIC WATER SUPPLY IN ELGEYO MARAKWET COUNTY, KENYA

BY

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DECLARATION

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This thesis has been submitted for examination with my approval as the University supervisor.

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DEDICATION

To my wife Nancy Kiplimo, my sons Timtim and Titus for their encouragement during my studies

ABSTRACT

As the demand for water in rural Kenya keep increasing due to high population growth, the quality of its supply is being compromised by agriculture related degradation. This study investigated the economic valuation of Moiben river degradation and domestic water supply to the surrounding community for sustainable protection. It employed Contingent Valuation Method to measure the objectives of study which includes; assessing the economic significance of Moiben river to nearby households; examine the relationship of agricultural productivity on degradation of Moiben River; estimating the willingness to pay and factors that influences the likelihood of Willingness To Pay responses for river protection and water supply. A sample of 384 households living along Moiben river in Elgeyo /Marakwet County was studied. Questionnaires were used to collect primary data. To achieve the total value, contingent market scenario was established. Results indicated that Majority of the respondents owns land below 10 acres while minority owns 41 acres and above. Majority of the residents use the river for domestic purposes. Moiben River has played a fundamental role in the lives of the people of Marakwet West. Agriculture is one of the main sources of water pollution. The average amount residents were willing to pay for river protection was Ksh 170 and an addition Ksh 196 for water supply. Based on the results, it was found that there was no statistically significant relationship between Willingness to Pay and age, gender, marital status, education, employment, land size, monthly income and distance from the river as determined by Pearson Correlation. Moreover, the results show that there was statistical significant relationship between household size and WTP as determined by Pearson Correlation. The study recommends that residents be sensitized on environmental protection to adequately address any potential environmental problems associated to water degradation from human activities. Since that there is willingness to pay for domestic water supply, the Government need to consider providing treated piped water

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LIST OF ABBREVIATIONS

ANOVA	- Analysis of Variance
CV	- Contingent Valuation
CVM	- Contingent Valuation Method
GIS	- Geographical Information System
GoK	- Government of Kenya
UNEP	- United Nations Environmental Programme
UNICEF	- United Nations Children Fund
WHO	- World Health Organization
WRI	- World Resources Institute
WTA	- Willingness to Accept
WTP	- Willingness to Pay

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CHAPTER ONE

1.0 INTRODUCTON

1.1. Background to the study

Water is an important element for both domestic and industrial purposes yet it is unevenly distributed (Masese *etal,* 2012). Water cover 70% of the earth surface making it our greatest resource(Akali *et al.,* 2011). According to Carpenter *et al*., (2011) fresh water on earth constitute only 2.5 % of the total water mass and about 68.7 % of this is locked in icecaps, 29.9 % in groundwater and only 0.26 % occur in lakes, rivers and reservoirs, while the remaining occur as soil and atmospheric moisture. It is therefore this small amount of fresh water that the Earth's population depends on to meet water needs in the right quantity and quality. This agree with Mitchell, (2000) that freshwater is a finite and essential resource.

Rural areas and the poor are seriously hit with water insufficiency due to inaccessibility; most of them rely on rivers and streams to meet their water need which are in most cases in remote areas with poor infrastructure. The Joint Monitoring Program of the WHO and UNICEF (2004), compared developed and developing countries on enhanced sanitation and provision of water connection sources. The findings were that those connected to enhanced water source vary from 54% in Haiti to 100% in Uruguay, 50 million people (9%) of the population in Latin America and the Caribbean do not have access to improved water supply, and 125 million or 23% did not have access to improved water sanitation'.

The above example shows that several countries of the world are faced with challenges in providing improved water service particularly in developing countries. While this being the case, World Bank (2006) gave interventions for countries to put in place in order to change the trend and achieve an advancement, such steps include use of various strategies like what

Latin America and the Caribbean use which involve; improving the efficiency of service providers by increasing investments in water and sanitation, introduction of innovative mechanisms for commercial financing, provision of subsidies and improve cost recovery; and expanding access to water and sanitation services more so to the poor by improving service quality, strengthening the capacity of service providers, redefining the role of the private sector in service provision, strengthening information systems and impact evaluations and improving regulatory frameworks(World Bank, 2006).

About 43% of Kenya's populations have poor access to clean water (Marshall Samantha, 2011). The distribution of this resource is limited both spatially and temporally (GOK, 2002). The distribution is put into 5 basins for easy management which are; Rift Valley, Lake Victoria, Athi river and Coast, Tana river and Ewaso Ng'iro. It is not evenly distributed among them; Lake Victoria Basin being with the highest water availability while Athi Drainage system being the lowest. Tana and Lake Victoria Basins have water surplus, and the other three experience water deficits (FAO, 2008).FAO (2008) estimated per capita water availability of Kenya to be 792 m^3 which falls below the scarcity threshold.

It is true that domestic water demand does not keep pace with water resource development (Odira, 1992). According to him, the existing data of water demand show that there is increase from 2073 MCM/year in the year 1990 and was expected 5817 MCM/year in the year 2010. Apart from demand and ever expanding farming activities, access to affordable water and discharging of untreated contaminants affects the water quality (Wambua, 2004). Major environmental problems affecting water quality is either from point or non-point or both source of degradation. Iwata et al., (2003), Mbaka, (2010), Booth and Jackson, (1997) identified anthropogenic activities and poor agricultural practice in riparian areas as the cause of reduced canopy cover, which raise sun's radiation, increase soil erosion and siltation in rivers. Dudgeon, (1992) cited scarcity of treatment for domestic wastes as a factor that

intensify the above. Another problem is the rivers that flow through fields for long distances which is expected to collect contaminants along the way which include fertilizers swept from farm lands causing pollution and making it unfit for domestic and human use (Shaw, 2004).

Water resource is considered by many to be free with no market value apart from payment for delivery by vendors or municipal. Therefore, rivers suffer from what 'Hardin (1968) described as the"tragedy of the commons". These "free" natural resources are over exploited hence environmental problems like; river pollution, soil erosion, and extinction of species of fauna and flora

According to the constitution of Kenya, (2010) clean water is a basic human right to every citizen. The World summit on sustainable development in Johannesburg (WHO/UNICEF 2004) stressed the importance of access to safe drinking water following the finding that about 1.2 billion people around the World drink unclean water which has been documented to be source of water related diseases that kill between five to ten million people, children being vulnerable to this. It is one of the Millennium Development Goals to make available safe water and basic sanitation which was adopted by the UN General assembly in 2000 (Goal 7 Target 10 of the MDGs). There is therefore need for a joint effort from all the countries of the world to strive at ensuring water is provided in the right quality and quantity.

Elgeyo Marakwet County main economic is Agriculture estimated to be 66.3%, the County has 16 gazetted forests with 23 community faced associations established. It is for this reason that the county identified agricultural, livestock and forest products to be the commodities forming the leading in traded goods, households with piped water is approximately 7,613 and the households that take over 30minutes to access drinking water is approximately 18,471(Elgeyo Marakwet CIDP, 2013). Moiben is faced with challenges of water pollution from both human and natural source which are non point in nature. Masese, *etal* (2008)

conducted a study to determine water quality in Moiben River and found out that degradation increase downstream, which agree to the findings of Sundblad et al. (1994), Moreau et al. (1998), and Huber et al. (2000) on similar studies. As mentioned earlier those living in rural areas and the poor get water from the rivers. This study is in one of the rural settings and is expected that residents get their water from river Moiben. The farming activities and other human activities are expected to cause water degradation posing a threat to the fauna & flora and human health in the region.

WRI, (2007) suggested that for third world countries especially those with water scarcity to achieve sufficiency throughout the year round, they should put their focus on management of water catchment areas. To achieve this, it is necessary to conduct an economic valuation of river pollution and to assess the economic value of improved local water services for rural residents (Johnson & Baltodano, 2004; Wasike, 1996).

Water resources being necessary inputs to production in economic sectors such as agriculture (arable and nonarable land, aquaculture, commercial fishing, and forestry), industry (e.g. power generation) and tourism, as well as to household consumption (UNEP, 2005), and in implementing most efficient social and economic policies that prevent the excessive degradation and depletion of environmental resources, it is necessary to establish their full value, and to incorporate this into private and public decision-making processes. A CBA of a policy or project with environmental impacts is complicated because many environmental resources (including most water resources) are public goods. A good is public to the extent that consumption of it is non-rival and non-excludable; it is non-rival if one person's consumption of the good does not reduce the amount available to others and non-excludable if it is not possible to supply the good only to those who choose to pay for it and exclude everyone else. Pure public goods cannot be provided by the price mechanism because

producers cannot withhold the good for non-payment, and since there is no way of measuring how much a person consumes, there is no basis for establishing a market price. Public goods are therefore not traded in markets as private goods are, and are thus often under produced or exploited by the market. This phenomenon is called a 'market failure' in economic terms. Both surface water and groundwater have public good characteristics in that people who extract them and use them are not paying their scarcity rents (both in terms of quality and quantity); they only pay the private extraction costs. When scarcity rents go unrecognized, these results in inefficiently high extraction or pollution rate over time and space (Koundouri, 2000). Other causes of market failure include insufficient or non-existent property rights, externalities, the lack of perfect competition (e.g., market power) and lack of perfect information.

Many Scholars agree that environmental good can be valued by determining the willingness to pay by the community through an organized project user groups and more so is to establish one. This study conducted an economic valuation of river to determine the willingness to pay for the provision of the improved domestic water supply and protecting drinking water from water pollution. Due to its nature of indivisibility, water is non-market commodity that cannot be optimally provided. The CVM (contingent valuation method) is a non-market valuation technique used to estimate the benefits derived from environmental goods and services (Carson, 2000; Carson and Groves, 2007). Measures of economic value are based on consumer theory which is in individual preferences (Cerda, 2005), consumer theory postulates that people express their preferences via the choices and tradeoffs that they make, given some constraints like income and time. Related to CVM is contingent behavior, this method is an example of direct approach of determining valuation.

1.2 Statement of the problem

Elgeyo Marakwet County has some of the best forests which act as source of many rivers in the County, which flows to other Counties. This forests supply fuel wood, honey, grazing, building materials, water, and medicinal herbs. According to the County CIDP, Members of the community especially the Marakwet, communally own the forest hence naturally conserve the forests. It is further reported that there is over-exploitation especially through overgrazing and illegal logging which agree with the findings of Cheboiwo on the study area to be having the best forest blocks of 40% forest cover (Cheboiwo et al 2012). According to Cheboiwo, Moiben river is expected to be affected due to the ongoing poaching of the indigenous trees which is attracting good market in the neighboring towns; illegal settlements, overgrazing and horticultural farming practices which demand a lot input of fertilizer. The GIS map by Cheboiwo show that most of the tributaries of the river originate from private farms. In addition is the introduction of cultivation of agriculture in the forest and the ban of the forest harvesting which aggravate the situation (Cheboiwo et al, 2012).

CIDP records that, the deforestation and destruction of water catchment areas has led to water shortages in some areas especially during dry spells. Water supply to major rivers in the county has declined significantly, making the residents of the vast Kerio Valley experience a drastic reduction in water for irrigating their farms and thus threatening livelihood security in the county and adjacent highlands. This is as a result of deforestation in the highland areas especially at water catchment areas. In conclusion, threats to fragile ecosystems within the county have been a major cause of concern. Deforestation, overgrazing and poor farming methods contribute to soil erosion and landslides especially on the hanging escarpments.

Moiben river catchment is encroached by landless people and those compensated were not willing to surrender the agreed land for conservation for example in chebiemit location, there

is wetland encroachment in the same location. The catchment of the rivers is reported in CIDP to have illegal settlers especially the following wards Embobut/Embolot, Kapyego, Moiben/Kuserwo, Kapchemutwa and Kaptarakwa. Water supply for domestic and agricultural purposes which influence economy and food security to riparian residents is expected to be affected by their activities (Ayivor& Gordon, 2012) and the natural Erosion process (Ontumbi, 2015) which is expected to cause increase in nutrients and siltation into the river, especially to the Chebara dam.

According to an environmental impact report of the year 2010 by Mangat Lel& Partners on the construction of Chebara dam, they pointed out that the catchment of the dam should be protected from pollution and destruction in order to achieve its objectives and maintain high retention potential of precipitation in the upper catchment. This study was developed from this background with the main aim to determine WTP of the respondents on the protection of Moiben river for continuous supply of goods and services.

Since Moiben River ecosystem provides goods and services and performs many functions that are potentially valuable to households then valuation is important for policy formulation and implementation. According to Martin, (2007) river valuation is an important tool for making informed decisions about efficient and equitable allocation of water among competing users. Valuation will help in understanding the relationship between the community and the river hence providing improved water quality at the water source (Mwami 2005; Lenehan and Martin 2007; UNEP 2008) this will ensure that the resource is available both within the present generation, between present and future generation, also it assures efficiency and equitable infrastructure investment in the water sector, efficient degree of treatment of waste and design of economic instruments: pricing, property rights, tradable rights' markets, taxes on depletion and pollution (Martin, 2007).

This study uses CV approach to assess willingness to pay for improvements in water resources management. CV is recognized throughout the world as the best tool in achieving good ecological status (Hanley et al., 2005). In his research, he discovered that economic values are not transferable between two different river systems in one and the same country. Scholars like Ready et al., (2004); Brouwer and Bateman, (2005); Scasny et al., (2006) are in agreement that there is no evidence in transferability of economic values for the same or similar environmental goods & services across countries and particularly in the field of water quality.

Moiben river will not assume the values of other rivers elsewhere to represent its value and subsequently make decisions based on them for its management, but will employ the above technique which has not been used in this river. This study aims to fill this gap in the literature. The main thrust of this study therefore is the use of WTP approach of CV to value Moiben river pollution and its improved domestic water supply to the surrounding community.

1.3 Objectives of the study

The general objective of this study was to investigate an economic valuation of Moiben river pollution and improved domestic water supply in Elgeyo Marakwet County, Kenya.

1.4 Specific objectives are:

i. assess the economic significance of Moiben river to nearby households
ii. to determine willingness to pay (WTP) and factors that influences the likelihood of WTP responses on river protection and improved water supply.
iii. examine the relationship between agricultural productivity and the degradation of Moiben river.

1.6. Hypothesis

1. There is no economic significance of Moiben river to nearby households.

2. Moiben residents are not willing to pay (WTP) any fee for well managed and improved domestic water supply.

3. There is no relationship between agricultural productivity and degradation of Moiben river.

1.7 Significance of the Study

Moiben River is the main source of livelihoods to the communities in Keiyo county Kenya. Chebara dam provides water that irrigates over 100,000 ha of land that would otherwise be unproductive under rain fed conditions and supply water to about one million inhabitants of Eldoret urban area and other rural communities. The water is collected from the network of seasonal and permanent tributaries flowing from the slopes of Cherangany hills catchment areas include koisungur, kapyego, kipkunur hill joining to form Moiben river. Cheranganyi hill is also a source of important wood products. Due to the shape and size of the forest blocks, the boundary being in contact with farmers is very long thus exposing it to rampant poaching of tree products, illegal settlements, overgrazing, cultivation and other illegal activities (Cheboiwo, 2012).

The study would provide information that may be useful for future planning and decision making in protecting Moiben river use from pollution and its existence. The findings and recommendations of this study would give useful knowledge to the management of Moiben river so as to make informed decision in providing sustainable services to the residents of Moiben, downstream dwellers and Eldoret town. The study could be applied to form a basis for further research on how to enhance river protection in third world countries. This would

lead to the generation of new ideas for better and more efficient management of natural resources in Kenya.

1.8 Limitations of the Study

The limitation of the research may look a bit complex when dealing with rural households but to eliminate errors and reduce bias, research clerks should be trained well and pre-testing of the tools should also be done before going to the field. Also simplification of the terms for respondents easy to understand for example instead of using polluter pay principle which is like imposing to them, you explain to them the importance of solving environmental problems caused by them for their own benefit.

1.9 Definition of terms

Pollution is composition change of water through addition of unwanted substance (chemicals, suspended and dissolved solids) that make it unfit for domestic and agricultural use.

Improve this is the addition of value of water by treating, storing and delivering to a destination. River is the permanent flow of water from one point to another throughout the year supplying goods and services.

Consumer theory is the way people express their preferences and constrains (income, time, etc) through the choices they make. It is concerned with how a rational individual decide on his consumption when faced with choices to make, he will choose that which suits best to his needs.

Contingent valuation method (CVM) is a method used to elicit individuals' preferences, in monetary terms, for changes in the quantity or quality of nonmarket environmental resources.

1.10 Scope of the study

The study will focus on the economic valuation of water in Moiben tributary for Chebara Dam, the study will be studied between the months of October, November and December, and the study will target a population of 384 households within Chebara Dam. The study will use a survey design to conduct the study; it will involve the use of questionnaires, interview schedules and focus groups as the data collection tools.

CHAPTER TWO

2.0 LITERATUREREVIEW

2.1 INTRODUCTION

This chapter reviews the theoretical and empirical literatures on the economic characteristics of river water supply to nearby households, the effects of agricultural productivity on productivity and economic valuation of improved management of river Moiben. This section intends to review the methodologies applied by other studies to solve the problem at hand. It also analyses studies that focus on the role of external effects on river degradation and water supply sustainability. Therefore, this section provides clearer information on the key variables as used in other studies.

2.2 Economic characteristics of rivers

Wetlands (lakes and rivers) play a critical role in the global water cycle, carbon cycle, nitrogen, cycle, climate change and ecological development and they provide habitats for wildlife (Wu, H.; Zeng, et al, 2013, 2015). They also provide functions such as a source of energy to drive machinery, as a source of water for both industrial, drinking, for obtaining food, for transport, as a defensive measure, for bathing and as a means of disposing of waste (Gibbons, 2006). In some countries of the world with forested regions such as Scandinavia, and Canada, they save much energy and cost by using natural means to transport large heavy logs downstream to the processing camps by floating them, Apart from the above positive effects of rivers, it also play a role in providing the habitat for many plant and animal species, and when put into a pipe, a river can also drive turbines to produce electric power (Lansing et al. 1998). The sand, gravel and coarse sediments generated are good for construction in most parts of the world. Rivers have been important in determining political boundaries and

defending countries for example the Mississippi in the North America and the Rhine in Europe are major east west boundaries in the continent.

Apart from this benefits, rivers can be a cause of negatively and losses through water pollution. Pollution related to drinking water protection areas may affect the quality of drinking water and cause tap-water suspension. Water suspension may also occur in irrigation water and industrial production water supplies. Recreational angling and boating activities can be impeded by pollutant-driven taste and odor problems or the influence of toxic substances (Dodds,W.K.; Bouska,W.W.; Eitzmann, J.L.; Pilger, T.J.; Pitts, K.L.; Riley, A.J.; Schloesser, J.T.; Thornbrugh, D.J. 2009). Water users are less likely to swim, boat, and fish during accidents and post-accidents due to health risks, unfavorable water appearance, or unpleasant odors. Environmental property values can decrease with the declines in surface water quality, groundwater quality and soil quality along pollution belts. All these negative impacts brought about by water pollution should be economically assessed. The potential damages originated from water pollution may affect human health, affect the recreational functions of surface water, cause large areas of fish deaths and reduction in aquatic product yields, intermittent water supplies and decrease environmental property values. etc. (Hong Yao, Zhen You and Bo Liu. **(**2015).

2.2.1 Damage to Human Health

Here human health damage refers to both the loss of human lives and the people poisoned (slightly, severely and very severely) due to a pollution accident. The number of damaged people could be determined during the process of the accident's remediation. Further some cumulative and persistent substances discharged in SWPAs may bring potential long-term negative effects on human health via environmental media (Hong Yao, Zhen You and Bo Liu. **(**2015).

2.2.2 Economic Valuation of a Fatality

Obviously, the problem of attributing an economic value to human life has important moral and social implications. A number of methods have been developed to assess the cost of a fatality. Qualitative verbalizations of willing-to-pay (WTP) for improved health and safety controls are commonly used evaluate the value of a life. The empirical results are interpreted theoretically in terms of preference construction processes, but in practice this method encounters ethical dilemmas, such as a reluctance to value life and budget constraints. According to "the year of potential life lost" proposed by the U.S. Centers for Disease Control and Prevention in 1982, life is valued in proportion to a person's potential economic production (Hong Yao, Zhen You and Bo Liu. **(**2015).The cost of saving an extra life (CSX) relates the value of a human life to the investment and expresses the investment made for saving one extra life by involving life expectancy in the calculation. Based on the utility of life, the life quality index (LQI), has also been used (Hong Yao, Zhen You and Bo Liu. **(**2015). Considering the availability of public information in China, the valuation method used in the study is based on the income per capita and the life expectancy, which is a similar measure to the LQI method proposed by Jatin. Besides, the cost of one life should also include the living cost of the dependents. Thus the cost of one fatality will be the function of the age of the victim and his annual income, the number of relatives depending on him, etc. Thus the economic valuation of one fatality contains two parts: the victim's own loss and the cost of the dependents' living needs. The victim's own loss is standardized according to annual disposable per capita income of urban residents (UI) or annual net per capita income of rural residents (RI) of the region where the victim resides. The life expectancy is assumed to be 80 and the same expectancy was used in the road accident compensation standard prescribed in the Road Traffic Safety Law of China. For the sake of fairness, for victims less than 60 years old the fixed number of years used in the valuation is 20 and for victims more

than 75 years old, the fixed number is 5. This exception is also consistent with the regulations in the road accident compensation rules (Wu, H.; Zeng, et al, 2013, 2015, Hong Yao, Zhen You and Bo Liu. **(**2015). Dependents comprise the children (less than 18 years old) and the elderly (more than 60 years old). In the valuation of the dependents' living expenses, the UI or RI value is just the consumption expenditure standard per capita and the duration of compensation dependents obtained is the same as in the victim's own loss estimation.

Two exceptions must be taken into consideration in some cases. If the age of the victim is unknown, it is assumed to belong to the "less than 60 years old" category. If the information of the dependents is unavailable, it is assumed that the victim has one ten-year-old child and two seventy-year-old elderly relatives. In this study it will employ CVM to establish willingness to pay for environmental protection and WTP for improved water supply.

2.2.3 Losses Due to Water Supply Suspension

Pollutants in surface water accidents might cause water quality, taste and odor problems. This may lead to water supply suspensions, including suspensions of tap-water for domestic use, farmland irrigation, cities' green belt sprinkling and industrial water. Thus the most direct functions of surface water will be partly lost temporarily. Water supply suspension may cause substitution consumption or industrial production shutdown. Functional replacement cost analysis is a common method in estimating the economic losses brought about by water supply suspensions (Pugliesi, A.C.V.; Marinho, M.D.; Marques, J.F.; Lucarelli, J.R.F. (2011), Kaiser, M.J.; Snyder, B. (2010). The value of this special function may be assessed by estimating the cost of the cheapest water replacement with the same effect

2.2.4 Losses Due to Tap-Water Suspension

In China, when tap-water access is suspended, wells are the usual alternative. Barreled water is the most common substitution during tap-water suspensions. Considering that people will consciously save water during a crisis situation, the minimum value, which is expressed in

the standard water quantity for a city's residential use (GB/T 50331-2002) and much less than the actual quantity of residential usage, has been taken as the consumption of barreled water per capita per day in the emergency situation (Hong Yao, Zhen You and Bo Liu. **(**2015).

2.2.5 Losses Due to Industrial Water Suspension

The cheapest substitution for industrial production water might be getting water from some other nearby river by pumps and making it usable after simple pretreatment. . In Kenya people living along rivers collect freshwater direct from the river, notable example is in Lake Victoria, where people fetch water for domestic use (Raburu et al., 2009). Historically rivers influence the form of urban cities and their neighborhoods and most industries dispose waste water into the rivers affecting the water quality (Lung'ayia, 2002).

2.2.6 Damage to Fisheries

Although rivers provide good service, they also destabilize the river bed affecting breeding ground of the spawning fish which depend on stable gravel formed for egg (Ngoran, 2015). The surface water pollution cause direct damage to fisheries leading to deaths through poisoning by pollutants and decreases the fish yield because of environmental changes hence reduced food supplies. (Hong Yao, Zhen You and Bo Liu **(**2015).

2.2.7 Damage to Recreational Functions

Recreation, including swimming, boating, angling and some other leisure modes (such as walking along the river bank, landscape appreciation etc.) is one of the primary functions of surface water. The replacement cost method is used in this section. It is assumed that all the recreational activities are interrupted for the duration of the pollution episode and the losses due to the recreational activities' interruption can be expressed as the sum of the four parts: losses of swimming, boating, angling and other activities (Hong Yao, Zhen You and Bo Liu. **(**2015).

2.2.8 Damage to Biological Diversity

Pollutants might decrease the richness of aquatic macro invertebrates, fish, and other aquatic primary producers. The value of biological diversity is difficult to precisely quantify (Hong Yao, Zhen You and Bo Liu. **(**2015).

2.2.9 Environmental Property Losses

Pollutants released in the accident deteriorate the water quality and decrease the value of the surface water. Pollutants may also settle in the sediments and the groundwater nearby might also suffer negative consequences due to pollutants' penetration (Schloesser, J.T.; Thornbrugh, D.J. 2009). Environmental property losses here are defined as these damages and denote the impairment of the value of environmental media, including the surface waters, ground waters and sediments. Pollutant clearance cost (PCC) analysis has been applied in this section. We use the cheapest price of pollutant removal from environmental media as the loss of environmental property (Hong Yao, Zhen You and Bo Liu. **(**2015).

2.2.10 Other Indirect Losses

SWPAs could bring some other negative consequences, such as human panic, fishery order reduction due to decreased confidence, residents' suspicion of governments' decisions, morale effects on coworkers, administrative costs (of the personnel, the department of health and safety, the prevention initiatives of local administrators), the loss of image for government and enterprises, etc.

In conclusion, a naturally functioning river provides a series of benefits and cost. Karr, (1999) explained this to be the ability of the aquatic ecosystem to support and keep key ecological processes and a community of organisms in undisturbed habitats as much as possible.

Economic value of water is essential and important to human well-being, its benefits can be market goods or non-market services (Pearce, 2001; de Groot, 1992, 1994; Daily, 1997; Costanza, 1997). This resource continues to be degraded at an alarming rate as indicated by the above scholars. The Millennium Ecosystem Assessment (MEA) (2005) found that ecosystem services have declined more rapidly over the past 50 years than any other period in human history. It is important to understand the economic significance of rivers for effective determination of their value to the community for meaningful protection against any form of degradation.

2.3 Effects of Agricultural Productivity on River Degradation

Rivers supply goods and services that are utilized in agriculture, households and industry, in most cases it involve; used by plants, animals, or industrial products. Some of this water do not get consumed and it goes back to the hydrological cycle in the gaseous form or retained in the soils which finally find its way to the aquifers. Water can be used without necessarily removing it from the streams or hydrological system like in hydroelectric power generation or boating. Such uses generally entail little or no consumption of water but do affect the location and time at which water is available for consumption by other uses (Young, 2006). Young concluded that it is not easy to control or prevent water use.

Water use degrades streams and rivers, causing a great damage to the quality of the aquatic resources (Postel, 1992). The effect ranges from sedimentation and eutrophication (Osano et al. 2003,). Land-use practices are identified as the main cause of degradation of aquatic ecosystems (Raburu 2003, GEF 2004, Okungu & Opango 2005, Wasike, 1996). Kibichii et al., (2007) and Kasangaki et al., (2008) identified land use changes as a result of rapid urbanization and clearance of forests for agricultural activities to be the major stressors of streams and rivers in East Africa, a notable example is the increased agricultural activities in

the Nzoia River Basin (GEF 2004), and animal overgrazing on the riparian areas has been found to increase ammonia and nitrite from animal wastes which are washed into streams (Kibichii et al., 2007). Other polluters are the human activities like sand mining, bathing and laundry in and near the stream which pose a lot of influence on stream habitat and biotic life as found by Mathooko, (2001); Raburu et al., (2009) in their studies.

Characteristics of demand for water for irrigation are related to quantity, location, timing and quality. Irrigation generally requires large volumes of water, which can be low in quality. This is in contrast to household use of water, for example, which requires low quantities of water of high quality. The large volumes of water required for irrigation usually have to be transported over some distance to the field. Agriculture is implicated in issues that concern water quality. Leaching of effluent from animal wastes, especially from intensive livestock production can pose a serious water pollution risk. Both return flows of irrigation water and precipitation runoff from arable land can pollute surface water with nutrients, herbicides, pesticides, salts leached from the soil, and sediment.

2.4 River Resource Payment

Water being a vital resource, living things cannot live without it. In most countries people pay for the water services they get from direct utilities and rarely do they pay for the indirect use based either on financial criteria (cost recovery), or economic criteria (efficiency pricing based on marginal cost) and/ or environmental criteria (incentives for water conservation) (Jones, 2014). This resource is essential to human life, and they are essentially public goods. Estimating the non-use values of public attributes requires a non-market economic valuation method to avoid "*The Tragedy of the Commons*". Two categories of non-market valuation methods, developed in previous research, are the revealed preference and stated preference methods (Monica, I.O.; Alex, S.M.; Barry, D.S. 2008). The stated preference method

involves the choice experiment and the contingent valuation method (CVM,) which is used to estimate the value of total ecosystem services .

Jones, (2014) found out that countries pay differently according to the regulations placed by the country. Water rate (water tariff) is commonly used by assigning water supply to a public utility which is owned publicly or privately, this often suffer from government regulations putting costs lower than the cash employed leading to poor maintenance hence the need for subsidies for both investment and operation (Jones, 2014). He found out that some countries provide residential water and wastewater services for free while others charge low price between US$0.03/m3- US$0.04/m3 (Saudi Arabia and in Havana, Cuba as well as Damsacus, Syria) and highest of betweenUS$7.35/m3- US$9.21/m3 (Aarhus, Denmark, Germany Perth, Brisbane, Adelaide and Sydney). The price was found to be based on treatment and delivery charges.

Walton, (2015) in his study noted payment to be on the consumption of individual family which is affected by the economic capacity and the demand. He further said that measurement of the payment was on the volumetric or at the fixed charges or surcharges or both. It is important to note that water being a bulky resource as well as an environmental commodity, it is difficult to place a price on it since one cannot practically take to the market buy or sell them. Water services may not be determined by the market factors associated to demand and supply as put by Dubgaard et al (2002) it is normally prone to market failure. Sherman, (2009) said that river use valuation is based on the welfare analysis of the river demand, and the value equals to the consumer’s surplus. Dupuit stated that the "maximum sacrifice expressed in money which each consumer would be willing to pay in order to acquire an object" provides "the measure of the object's utility". Marshall (2009) defined the

"economic measure" of a satisfaction as that which a person would be just willing to pay for any satisfaction rather than go without it.

Therefore, individual value on something is determined by its worth to him and not its cost. Thus, to produce an item may be cheap where its total cost is low, but to the owner it is highly valuable, that is the total value to him is large. From studies it has been found that that household WTP reflect much more than simply a household's income, an examples being the Newala District of Tanzania where households were found to be extremely poor and spend several hours a day collecting water during the water scarce season, with their small income they are WTP 8 percent to access water from public taps within their village (World Bank Water Demand Research Team, 1993, Whittington and Swarna, 1994, Whittington et al, 1988).

Young, (2006), demonstrates economic valuation at the catchment scale through investments that capture, store, deliver and treat new water supplies, and through reallocation of water supplies among water-using sectors. However, the functional perspective enables more effective consideration of river not just in terms of water supply but also with regard to other dimensions, including water quality and supply reliability. It is important to determine what the total value of the river resource is for better management.

There are several techniques that are used to value river goods and services. That is, contingent valuation, contingent behavior, and conjoint/choice analysis methods are examples for direct approaches [18]. The travel cost, averting behavior, and hedonic price methods are the indirect approaches (Braden and Kolstad 2001), Freeman 2003), Pearce, Whittington and Georgiou 2004), Georgiou et al, 2007). The hedonic property method isolates the property value differential paid by a household for having a home along a river with improved water quality as compared to degraded water quality. Variation in visitors

travel costs to the river can be used to trace out the demand curve for recreation at the river. Loomis and Walsh, (1997) used demand curve to estimate the consumer surplus of recreation with improved water quality. An individual would pay for preservation of a natural resource today so that future generations can have enjoyment from it (Krutilla, 1967; Loomis and White, 1996). Whereas in some studies like the case of Whittington and Swarna, (1994) they used indirect methods in estimating WTP by households for the improved water services,

This study employ direct method of estimating contingent valuation(CV) of river Moiben pollution and its domestic water supply to the surrounding community for sustainable protection in determining WTP. A number of researchers have applied contingent valuation (CV) to determine household willingness to pay for water services and protection from degradation. CVM is widely used in many fields, such as measuring valuation for publicly financed health care services, assessing landfill mining projects (Marella, C.; Raga, R. 2014), understanding public perceptions of nuclear power (Sun, C.W.; Zhu, X.T. (2014), conducting an economic valuation of forest ecosystem services , and so on. Since water is viewed by most communities especially in developing countries as an essential commodity and freely provided hence do not care on how it is being used which in most cases lead to over exploitation 'Hardin (1968) described it as the tragedy of the commons, which finally result to environmental problems like; degradation, soil erosion, and extinction of biotic species. Mu *et al* (1990) found that households may choose to continue to use their traditional water sources even if improved water source is available. It is important therefore to elicit factors that influence the behavior of consumers for improved water pollution control and domestic water supply if we must reduce degradation and make informed decisions about the social value of improving water quality (Saliba et *al*, 1987, Colby, 1989). Market failure associated with river production and delivery do not give the real value of a river. Cole, (2006) gave

such failures to include externalities, recharge constraint, imprecise information, large fixed investment costs, and declining average costs of delivery. Scholars agree that resource value is the first step towards development of policies and management options for the environmental resources as noted by Martin (2007).

Walton (2015), Estache *et al.* (2002) and Foster *et al.* (2000) used affordability indicators to measure energy poverty in Latin America. They wanted to compare the actual ability of poor households to pay their bills and their willingness to pay. Another study on water affordability is OECD (2003) who used income group, family type and geographic region to assess the affordability. The findings from both studies indicate that water charges in household expenditures were inversely related to income. This agree with Munisinghe et al,(1993),Choe et al (1994), Mcconnel(1997), and Wasike (1996) that income had a positive significant on WTP. Other studies have been conducted in Brazil by Casey et al. (2006) in the Amazon Basin and Fujita et al., (2005) to assess WTP for improved access and reliability of water supply. In terms of demographic characteristics, the results from both papers show that age had a negative effect on WTP, while Income was found to be insignificant on WTP.

Carlsson and Martinsson (2007) used a choice experiment analysis to look at WTP of Swedish households for avoidance of power outages. From his study he found out that respondents living in big cities and in detached or terraced houses have lower WTP to reduce power cuts whereas older respondents in their sample had a higher WTP than younger respondents, and gender was an insignificant factor. Hament et al, (2001) in his study found that education level of respondents had a positive and significant effect on WTP. Whereas Sumukwo, (2007) found out that income had no significance on WTP. In a study by Carlson and Martisson, where he used a choice experiment to analyze WTP for improvement in electricity services discovered that older respondents were less likely to pay for increased

reliability in electricity services, the unemployed showed negative effect on WTP, while household size had a positive effect on WTP.

The study by Zhang, (2014) examined the determinants of farmers' WTP for ecological compensation of the Poyang Lake Wetland area in China and their payment levels, using farmer household-level survey data. The CVM and Heckman's two-step model were employed. The finding was that 46.58% of farmers had positive WTP, with their average annual WTP to be at $64.39 per household. Other factors found to have a significant correlation with the farmers' WTP are arable land area, household income, emphasis on improvement of wetland resources, residential location, and contracted water area. Loomis J. et al (1995) wanted to know if distance affects WTP for public goods and non-use values. His study found that as distance increased WTP decreased and discovered that older individuals were less likely to pay.

Other studies on water degradation are; The CV study by Greenley *et al* (1981) in South Platte River Basin in Colorado; David (1971) in Wisconsin; Paul P. Appasamy and Prakash Nelliyat (2007) on economic valuation of ecosystem who estimated the loss of ecosystem services due to industrial degradation which was done in India and found out that the community lost their resource to degradation and there was need for compensation; Dumas et al, (2005), gave an example of benefit transfer by estimating the value of water quality improvements for the Cape Fear River in North Carolina; Peter Whiting & Denisa Georgescu, (2009), did some work in Economic Valuation of the Canadian Heritage River System where they used statistics and went further to give a general information on ecosystem services and their connection to the economy by estimating the partial dollar value of 12 ecosystem services in the Puget Sound Basin. From his studies, he came up with the following result: Ecosystems within the Puget Sound provide between $7.4 and $61.7 billion in benefits to people every year. Lyon and Farrow (1995), studied household WTP for

freshwater benefits using an econometric relationship. His findings were that US Clean Water Act programmes, as it is planned, may have incremental costs that exceed their incremental benefits. Carson and Mitchell (1993) while evaluating the national water quality benefits from the Clean Water Act by examining the WTP for increased water quality for all rivers in the US came up with Table I of p 2446 which elaborate the benefits from an Improvement in Freshwater Quality as; Recreational, Commercial, Municipal, Agriculture, Industrial/commercial and Aesthetic. Also Smith, (1987) and Fisher and Raucher, (1984) believed that there are benefits in improved water quality.

It is therefore clear that the best way to achieve true value of the world's nature-based assets is in the use of Economics of Ecosystems and Biodiversity (UNEP, 2010).This study determined factor that affect WTP in Moiben river by applying ecosystem economics.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter addresses methodological techniques used in the study. It covers work/empirical design and sampling procedure, data collection techniques, data analysis and CVM application

3.2 Study area

Elgeyo Marakwet County covers a total area of 3029.9 km2 which constitutes 0.4 percent of the country's total area. It extends from latitude 0^0 20′ to 1^0 30′ to the North and longitude 35^0 0′ to 35^0 45′ to the East. The county is divided into three topographic zones namely: the Highlands, the Kerio Valley and the Escarpment: all of them separated by the conspicuous Elgeyo Escarpment. Each of the three zones has attracted a different settlement pattern. The Highlands which constitute 49 percent of the county area is densely populated due to its endowment with fertile soils and reliable rainfall. The variation in altitude from 900 m above sea level in the Kerio Valley to 2700 m above sea level in the highlands gives rise to considerable differences in climatic conditions. The temperatures in the Highlands range between 15°C during rainy season and 23° C during the dry season whereas on the Escarpment and the Kerio Valley, temperatures can be as high as 30°C during the dry season and as low as 17° C during the rainy season. There is also marked variation in amount of rainfall in the three zones. The Highlands receive between 1200mm and 1500mm per annum while the Escarpment gets rainfall ranging between 1000mm to 1400mm per annum. The Kerio Valley, on the other hand, receives between 850mm to 1000mm of rainfall per annum.

Long rains usually fall between the months of March and July every year while the short rains fall between August and November. County's source of water include; Kipkunur and Kerer in Cherang'any water tower is the source of water for all the major urban areas in the county: Kapchemutwa and Kessup water catchment areas are sources for Iten water supply and Tambach water supply systems respectively: Toropket and Kiptaber forests which are the sources of Chepkaitit River serve Kapcherop.

Politically, the county comprises of four constituencies, namely; Marakwet East, Marakwet West, Keiyo South and Keiyo North. According to the 2009 National Population and Housing Census, the county's total population was 370,712. The inter-census population growth rate for the county is 2.7 percent per annum. The population of the county has been increasing over the years hence exerting pressure on both natural resources and social amenities. This therefore calls for investment in economic and social facilities such as health services, education, ICT, agriculture, livestock among others to provide both food and employment opportunities. It is worth noting that population analysis by selected age groups is crucial for accurate planning for provision of social infrastructure (CIDP, 2013).

The study area is Moiben River which is the main source of livelihoods to the communities in Elgeyo/marakwet County Kenya. Moiben River originates from Kipkunnur forest on the western side of the Kerio escarpment at 2 400 m above sea level (GoK 1973). The river is approximately 81 km long from the source to Nzoia River (Wasike 1996). The river drains its water to Chebara dam before joining with other tributaries to form Nzoia River. Moiben river provides water that irrigates over 100,000 ha of land that would otherwise be unproductive under rain fed conditions and supply water to about one million inhabitants of Eldoret urban area and other rural communities. Due to the shape and size of the forest blocks, the boundary

being in contact with farmers is very long thus exposing it to rampant poaching of tree products, illegal settlements, overgrazing, cultivation and other illegal activities.

The study targeted a total population of 384 respondents living 20km away from Chebara dam towards the source along Moiben River 5km away on both sides of the river in Cheptongei location and Chebiemit location. The household is the central unit of the study. The study area was stratified into two locations where 384 households were randomly sampled for effectiveness and good representation of the study area.

3.3 Theoretical Framework

This study used consumer theory as a framework of analysis. Consumer theory postulates that people express their preferences and constrains (income, time, etc) through the choices they make. It is concerned with how a rational individual decide on his consumption when faced with choices to make, he will choose that which suits best to his needs. Preference is considered to be transitive which mean that if presented with three goods ABC, it is believed that $A > B$ and $B > C$, then there is no way that $C > A$ instead $A > C$.Therefore related to CVM are contingent behavior, and choice analysis methods which are direct approaches to estimate economic value which rest on the consumer theory. The purpose of the contingent valuation method (CVM) is to elicit individuals' preferences, in monetary terms, for changes in the quantity or quality of nonmarket environmental resources. CVM valuation is dependent upon a hypothetical situation whereby a sample of the population is interviewed on their willingness to pay or accept compensation for a change in the environmental quality / quantity.

3.4.0 Conceptual Model

A rational individual faced with a choice of water use, he will choose according to the accessibility and his economic uniqueness as indicated above. Each individual attaches a marginal utility to each characteristic of a water source such as price, quality, and reliability (Wasike 1996). A utility-maximizing individual will select source that yields maximum utility by the assumption that he will put together the utility obtained for all attributes of each source. (Lancaster, *1965,* McFadden, 1981, Bockstael et al, 1987)

if for example; taking q, to represent the quantity of water demanded by household;

n to represent specific use,

b to represent the source

The water demanded by household *n* from source *a* for that use, will be q_{an}

If a nearer source *b* available while use and quantity is constant the household will choose q_{bn}

It is expected that household will choose from among the set of possible water sources that gives him greater or equal utility to the previous

that is. $U_{bn} \geq U_{an}$ where $a \neq b$

The assumption was that the respondents are willing to pay an amount and the amount varies with each respondent across the total population which is dependent on the combination of several factors as indicated from *1*to *9*.

$$WTP = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + e$$

Where:

WTP= the willingness to pay for the utility (dependent variable)

Y= Service quality`; β =Beta

x= factors affecting service quality (independent variables)

e = disturbance term

The random term is meant to solve for households that may not be consistent to correct the disturbances as noted by Ben-Akiva and Lerma, (*1985*)**.**

3.4.1 Model Specification

The empirical analysis was carried out using multiple regressions. The multiple regression formulae used was:-

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + e$$

Where:

Y= WTP value of river pollution

X_i to X_n are the socio-economic factors

X_1=AGE:- it is expected that as the age increase the WTP decrease, older people demand for river goods and service is likely to be less.

X_2 = SEX:- women tend to use more water than men due to the nature of their daily domestic activities

X_3=Marital Status:- married people require more river goods and services for now and the future then WTP will be higher for the them.

X_4= level of education:- well informed people are expected to set aside an amount to pay more for quality products than get free but poor services water resource included.

X_5= size of the land: -people with smaller piece of land are expected to be more willing to pay for the service than those with bigger piece. This is because those with smaller farms will want to do more intensive farming which require more water that those owning bigger pieces.

X_6= family income:- in microeconomics increased income often leads to higher WTP. The reason is that more disposable income is available.

X_7= distance from the river: - those living near the rivers are in most cases affected more by any change on the quality and the quantity of the river thereby increases the WTP. This means that the further the person lives the less likely the WTP.

β =Beta and therefore β_i to β_n are predictors

a= the constant

e =error;

3.5 Empirical design

This study adopted a field survey research design using CVM. Besides, the design was used because of its descriptive nature in order to assist the researcher in collecting data from members of the sample for the purpose of estimating the population parameters.

3.6 Target population

A survey design was constructed to solicit household responses to economic valuation of Moiben river degradation and domestic water supply in Elgeyo Marakwet County, Kenya. A pre-testing of the survey instrument was conducted among 20 randomly selected households along Kipkaren river prior to implementation of survey. The findings were that the respondents were willing to pay. Selections of villages to be sampled were based on their proximity to the river as from the information provided by chiefs of Cheptongei and Chebiemit locations.

In order to get samples representative a population of Elgeyo Marakwet County as per the county projection stand at 460,092 people. Number of Households stand at 90,548. The target population under study constituted residents living at a distance of up to 5 Km away along the

river. The targeted respondents were 3,406 respondents from Cheptongei location and 3,522 from Chebiemit location making a total 6,928 respondents as provided by the local administration.

3.7 Sample size determination

The sample size employed for the identification of sample from target population was scientifically computed as recommended by Mugenda and Mugenda(2003)as follows;

$$nf = \frac{n}{(1 + \frac{n}{N})}$$

Where;

nf = Sample size (when the population is less than 10,000).

n = Sample size (when the population is less than 10,000); 384.

N = Estimate of the population size;

The sample of respondents was determined using the formula adopted from Mugenda and Mugenda (1999). The formula: $n = Z^2(pq)/d^2$

Where

n = Desired sample size

Z = the standard normal deviate at the desired confidence level (Z = 1.96)

P = the proportion in the target population estimated to have characteristics being measured

d = the level of statistical significance (0.05)

q = 1-p. (Probability of event not taking place)

At 0.05% confidence limit Z = 1.96, hence

$n = 1.96^2(0.5 \text{ X } 0.5)/ 0.05^2 = 384$

3.8 Methods of Data Collection

In this study, researcher used an open-ended WTP questionnaire so that responders would not be restricted by defined values (as in binary choice or closed-ended questions).The researcher used oral interview and a checklist on the open ended contingent valuation questionnaire designed according to previous studies. The basic model for valuation of non-market goods is the CVM.

The power of the method is that it elicits values that members of a society place on environmental goods in totality as opposed to valuation of a resource for a particular role. The questionnaire were the most appropriate research tool as it allowed the researcher to collect information from a large sample with diverse backgrounds; the findings remain confidential, saves time and since they are presented in paper format there is no opportunity for bias.

The survey was carried out by the researcher and two assistants. Prior to the exercise the researcher they were trained on the tool by an expert. Primary data was from household on socio-economic and household profile in part A, water supply, quality and quantity in part B, river use, degradation, and protection in part C and willingness to pay in part D. Prior to the commencement of data collection, the researcher obtained all the necessary documents, including an introduction letter from the University.

From each of the two locations (Cheptongei and Chebiemit) a total of 384 households were selected from the target population where one respondent per house-hold was interviewed and since the programme had been sensitized the day before. Questionnaires was issued to those people who were able to read and write, they were then to fill in the questionnaires

while for those who did not know how to write and read were provided with volunteers to assist them with strict instructions not to influence the respondent answers.

3.8.1 Contingent market survey

Kibowen, (2006) used the Kaldor-Hicks model modified into a conventional willingness to pay econometric model by making WTP the dependent variable against independent variables. This study modified Kaldor- Hicks model to fit the study as WTP= F(Y,S,E,H,A). The households are either willing to pay or not. It is for this reason that the use of the probit model. But for this study, logit model was employed. Logit model is preferred by most researchers due to its nature of distributing error term independently, identically according to the value distributed whereas in probit model it assumes that the distribution is normal.

According to Deaton and Muellbaner (1980) logit is easy to estimate and interpret. This model is compatible to human behavior and it can forecast trends which conform to the expectations like introducing payment of a service charge to protect catchment, it is assumed that the acceptance of the idea would be accepted slowly at first then rapidly Hebolen (1983).

The logit bid model is as follows: $L_W = +(Logit(\pi) = \alpha + \beta_1 X_1 + ...\beta_n X_n + e$

Variables under this study were:

Dependent variables

WTP_{1-WTP} charge for willing to pay for improved river protection from degradation

WTP_{2-WTP} charge for willing to contribute extra money for improved domestic water supply

Independent variables

age, sex, household size, marital status, land size, employment, income and level of education and distance from the river.

$$L_W = +(Logit(\pi) = \alpha + \beta_1 X_1 + ...\beta_n X_n + e$$

L logit

α constant β co-efficient for i^{th} variable

X represents economic and demographic factors influencing the WTP(w),

w= 1 if household would be willing to pay service charge and

w= 0 if the household is not willing to pay.

3.8.2 The payment vehicle

It is also very important to select a realistic payment vehicle (*i.e.*, how respondents pay the WTP amount) in CVM. Taxes and donations are often used as payment vehicles associated with preservation values. The payment vehicle to be used in this study was in the form of community cess for the protection against degradation and destruction of the river and its related resource; this is because the most understood method used by the leadership in collecting revenue. It was explained to the community how the collected revenue would be used to protect the river.

3.9 Validity and Reliability of Research Instrument

According to Mugenda and Mugenda (2003), reliability refers to the degree to which the research instrument can yield consistent results and data from repeated trials. Validity on the other hand is the degree to which results from the analysis of the data actually represent the phenomenon under study.

The researcher explained questions more clearly using face-to-face interviews. Responses to open-ended questionnaires are likely to minimize standard error and lower estimates of central tendency hence preventing bias. In addition, the researcher finalized the WTP

questionnaires and the pre-testing process with the study supervisor to guarantee validity and make the questionnaire more clearly to respondents.

In addition, the hypothetical bias was handled by good public relations. Strategic and instrument biases were addressed by informing respondents that everyone would be required to pay and either cash or in kind. The inclusion of pictures and bidding procedure was used to mitigate the problems of information and starting point biases.

3.10 Data Analysis and Presentation of Findings

Data analysis adopted Mugenda and Mugenda, (2003) with the aim of bringing order, structure and meaning to the information collected. The analysis used descriptive statistics which adopted quantitative analysis in order to achieve the objectives of the study. The data analysis tool that was used was the SPSS, Multivariate analysis. Numerical values was assigned to responses (coding) in the questionnaires to represent measurement of variables, then the data analyzed and presented. All the tests were carried out at alpha level of significance of 0.05. Then finally the findings were presented in tables and charts showing frequencies and percentages with corresponding descriptions.

3.11 Ethical Considerations in Research Involving Human Participants

The researcher explained to the respondents about the research and that the study was for academic purposes only. It was made clear that the participation is voluntary and that the respondents were free to decline or withdraw any time during the research period. Respondents were not coerced into participating in the study. The participants had been informed consent to make the choice to participate or not. They were guaranteed that their privacy was protected by strict standard of anonymity. Permission to conduct research was obtained from the local administration of Chebiemit and cheptongei.

CHAPTER FOUR

4.0 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

This chapter presents the study results and discussion. The first part presents the response rate and demographic information of the respondents. The second part analyses the economic significance of Moiben River to neighbouring household. It presents results of the findings of the size of the land owned by the individuals living at distances of up to 5 Km from the river, the distance from the land to the river and how the resources found in the river are used. The third part of this chapter analyses the effects of agricultural productivity on degradation and presents results on the sources of degradation, levels of degradation and ranks the current protection of the river resources.

The fourth section analyses economic value of the improved management of the river and present results on the size of the land owned by the individuals/household, size of the household and the monthly income of the respondents. The fifth section present the economic implication of the river, it presents results on the quality of the river, relationship between fertilizer application and crop yield. The researcher issued 384 questionnaires to the respondents. The 359 of the total questionnaires were filled and returned.

The results obtained are shown in the table 4.1 below.

T**able 4.1 Response rate**

Questionnaires	**No**	**Percentages**
Received	359	93.49
Unreturned	25	6.51
Distributed	384	100

The results indicate that the response was not 100%. This shows not all the sampled population was not willing to participate in the survey.

4.2 Socio-Economic and Demographic Characteristics of Households Sampled

4.2.1 Introduction

For the researcher sought to acquire information on the background of the respondents, the researcher classified the respondents into two groups based on their gender.

4.2.2. Gender of the Respondent

The results obtained are shown in the table 4.2 below.

Table 4.2 Gender of the Respondents

Gender	Frequency	Percent
Male	196	54.6
Female	163	45.4
Total	**359**	**100**

According to Table 4.2 the study show that 54.6% of the respondents were male and 45.4%were female respondents. Majority of the respondents were male showing that the study captured more male than female. This signifies that the socio-cultural structure of the community considers a man as the head of the family and lowering the value of female. The research incorporated both genders in the study so as to avoid gender biasness.

4.2.3 Age of the Respondents

The findings obtained are shown in the table 4.3 below.

Table 4.3: Age of the Respondent

Age	Frequency	Percent
18-27	98	27
28-37	94	26
38-47	83	23
48-57	53	15
58 and above	31	9
Total	359	100.0

The study as represented in the table above revealed that 27% of the respondents were between the age of 18-27 years, 26% were between 28 and 37 years, 23% of the sampled group were between the age of 38 and 47, 15% of the respondents were between 51 and 60 years and finally 9% were above 60 years. The findings show that as the age increases the population decrease showing that the younger generation is in increase hence labour is in abundant in the region and dependency ratio is low. This has long term impacts on general population which require planning on resource use. Also willingness to pay is expected to be affected positively.

4.2.4 Marital Status

The results are shown in the Figure 1: below;

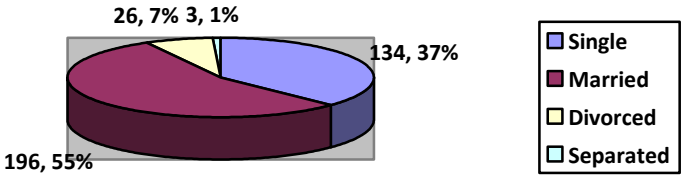

Figure 1: Marital status

Majority 55% of the respondents was married and the reason is because the society attaches value to the family set up and the single respondents were 37% showing that there is a larger number of people who are not married in the society. This may mean that the marriage age is rising in the community. The small percentage in the divorced category 7% and separated 3% indicate the society do not encourage disintegration of the family setting. The research shows that though most of the respondents were young they were also married hence shows that they are adults and can give reliable in answers.

4.2.5 Education Level of the Respondents

. The findings were then presented in table 4.4;

Table 4.4: Education Level

Education Level	Frequency	Percent
Primary	90	25
Secondary	183	51
College	61	17
Degree	16	4
Masters	9	3
Total	359	100

The overall indication show that most people do not go beyond form 4. Secondary school leavers was leading respondents at 51% showing that most of them have basic knowledge then able to read and write; Results from the findings also shows that 25% of the respondents were primary school leavers, 17% of the respondents completed College, 4% of the respondents had degree and 3% of the respondents were at masters level. This indicate that literacy is higher, bigger population able to read and write. The county has a vital resource hence need to enhance by providing more tertiary institution and give more incentives for advancement in education.

4.2.6 Employment

The results obtained as per respondent is shown in table 4.6 below.

Table 4.5; Occupation of the respondents

Occupation	Frequency	Percent
Unemployed	88	24
Business persons	107	30
Farmer	110	31
Civil servant	41	11
Teachers	13	4
Total	359	100

The highest percentage was that of the farmers at 31% meaning that the society rely most on farming as the source of income hence water requirements for both irrigation and domestic purposes is high. The 30% of the respondents engaged in business meaning that the majority understand economic factors that can affect livelihood. Study revealed that 24%of the respondents were unemployed, 11% were civil servants and finally 4%of the respondents were employed with Teachers Services Commission. Majority of the respondents were farmers hence make use of the river for irrigation purposes.

The farming activities include maize, beans, vegetable and millet plantation. Livestock rearing include cows, sheep, goats and hens. About 20% of the residents engage themselves

in small scale farming, 8% in rearing and the rest 3% of the respondents rely on the environmental goods for their daily activities which mean that protection of the river is necessary.

4.2.7 Size of the Land

The table 4.6 below shows how land is being used;

Table 4.6: size of the land

size of the land	Frequency	Percent
0-10 acres	160	45
11-20	124	34
21-30	49	14
31-40	15	4
41 and above	11	3
Total	**359**	**100**

The study findings revealed that most (45%) people own land less than 10 acres meaning that most people do small scale farming which in most cases is intensive farming, 35% have 11-20 acres of land, 14% of the sampled respondents have land range between 21-30 acres, 14% said they have land size between 31-40 acres and finally 3% of the respondents had above 41 acres of land. This has implication on land use.

4.2.8 Household Size

Findings are presented in the table 4.7 below.

Table 4.7; Household Size

Household Size	Frequency	Percent
1-3	106	30
4-6	138	38
7-9	72	20
above 10	43	12
Total	**359**	**100**

The majority of the respondents (38%) recorded between 4 and 6 members revealing that impact on the river is expected to be felt because of their daily activities which include domestic, agricultural, and industrial and some commercial activities. The other leading category is family size between 1-3 members which is 30% of respondents this means that the most families are of the young generation who are active and therefore need more of environmental goods and services, 20% said to have between 7 and 9 members and finally 11% said members of their family were 10 and above.

4.2.9 Family Monthly Income

The researcher sought to get information on the total monthly income earned by all people in every family. Findings are presented in the table below.

Table 4.8; Monthly Income

Monthly Income (Kshs)	Frequency	Percent
below 10,000	151	42
11,000-20,000	141	39
21,000-30,000	48	14
31,000-40,000	11	3
Above 41,000	8	2
Total	**359**	**100**

From the table 4.8 above it clearly shows that 42% of the respondents reported that their family earns less than ksh. 10,000 meaning that most members of the society work in low earning related jobs, 39% said their family income is between ksh. 11,000 and ksh. 20,000 combining this, we get 82% meaning that the population earning less than ksh 20,000 are many in the society, 14% said it's between ksh. 21,000 and ksh. 30,000 while 3% stated a figure between Ksh. 31,000 and ksh.40,000 and 8 respondents representing 2% said above 41,000.The above is expected to affect willingness to pay for environmental services because the society income is low.

4.3.0 Economic Significance of Moiben River to the Household

In analyzing the economic significance of the river to the household the researcher wanted to know the size of the land owned by the household living beside the river, the distance from the land to the river and how the resources found in the river are used.

4.3.1 Land Distance from the River

The findings are presented in the table 4.9: below;

Table 4.9; Land distance from the river

Distance	Frequency	Percent
below 1 km	118	33
2 Km	132	37
3 Km	69	19
4 Km	27	8
5 Km	13	3
Total	**359**	**100**

The findings show that the highest percentage of 37% of the respondents have their land located 2 km, 33% of the respondents live 1 km away from the river meaning biggest population live near water resource. This is expected to have an impact on the resource quality and quantity, 19% of the respondents live 3 km away, 8% of the total sampled group said 4 km away from the river and finally 3% of the sampled group confirmed that their farm is located 5 km away from the river. The distance from the river is expected to influence the willingness to pay.

4.3.2 How Resources Found in the River are Used (eg. fish, water, reeds,)

To find economic significance of the river, researcher investigated how the resources found in the river are used. Respondents gave different views and are presented below;

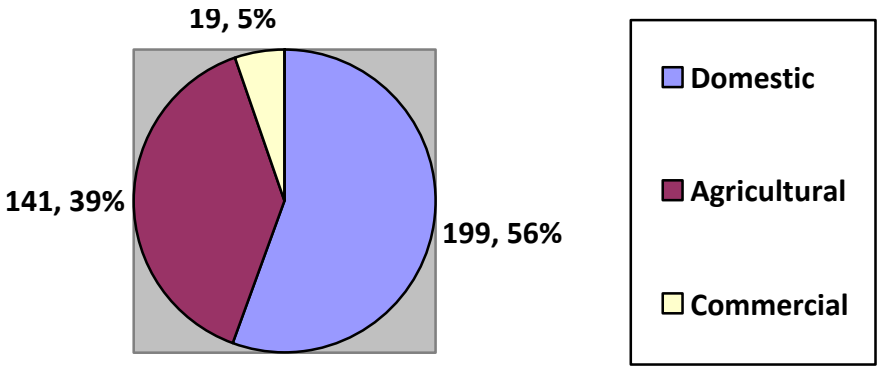

Figure 2: River Resource Utilization

Results show that 56% of the respondents said that resources from the river are used for domestic purposes. This means that most people keep livestock and that most people depend on the river directly for domestic water use, 39% attested that agricultural purposes showing that most people do irrigated agriculture which is known to use a lot of fertilizers that cause pollution to the rivers and 5% of the respondents said river resources are used for commercial purposes showing that the community do not put more emphasis on commercial activities. In conclusion, river is mainly used for domestic and agricultural purposes.

4.4.0 Effects of Agricultural Productivity on Degradation of the River

4.4.1 Rate of Resource Use

The researcher sought information from the respondents on the rate of resource usage found in the river. The aim was to know how the resources found in the river are used and at what rate.

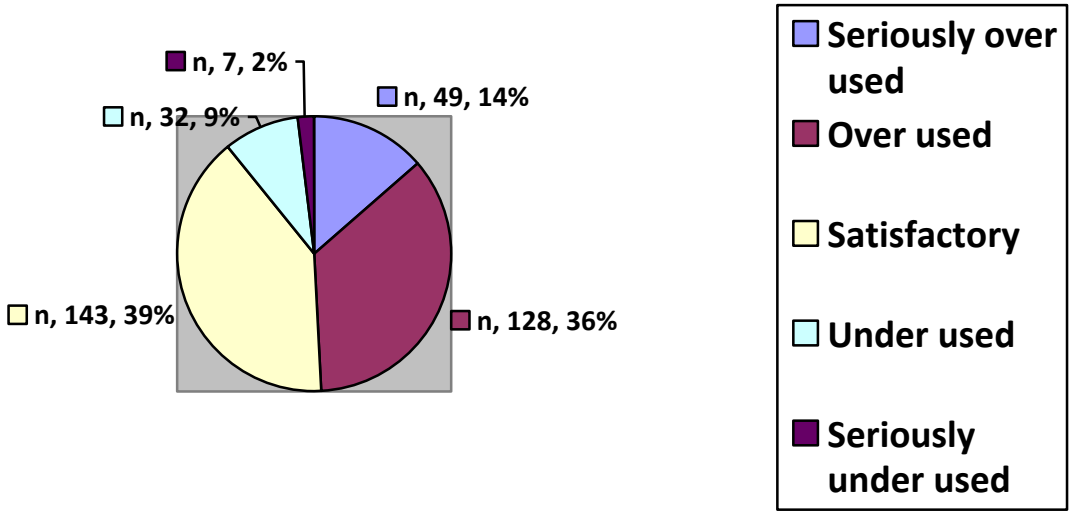

Figure 3: Rate of Resource Use

The highest percentage 39% of the respondents were of the view that the resources were satisfactorily used meaning no serious harm on the river but 36% said the resources are over used meaning that during the time of use, there is excessive withdrawal of the resource by those using the resource thereby warranting for regulation use. Those who recorded river resources to be seriously over used were 14% and finally 2% of the respondents said the resources are seriously under used.

4.4.2 River Usage

The researcher sought information from the respondents on how the river is used by the neighboring community, and classified the sampled data into different categories based on

their responses this was to obtain competent response from the residents. The findings are presented in table 4.10.

Table 4.10 River Usage

River Usage	Frequency	Percent
Household	263	73
School Supply	65	18
Industrial Use	13	4
Municipal Use	13	4
Other	5	1
Total	**359**	**100**

The majority of the people expressed to use the river as household as can be seen in the table above that 73% of respondents use for household and 18% said river resource is used for school supply, 3% confirmed that water is used in industries, 3% said municipal use and 1% confirmed that water from the river is used for commercial purposes. This indicates that the people of living around Moiben river utilize water for household needs.

4.4.3 Source of pollution

The study sought to find out sources of degradation to Moiben River and the results are presented below;

Table 4.11: Source of river pollution

Source of pollution	Frequency	Percent (%)
Domestic	121	34
Industrial	106	29
Natural	78	22
Agricultural	32	9
All Above	22	6
Total	**359**	**100**

Domestic waste is the leading polluter to the river meaning that pollution is mainly from non point source. The study results as the respondents said earlier, water is polluted by industrial waste showing that there is presence of industrial activities practiced by the community and mainly associated with timber harvesting. The third cause of the river pollution is the natural causes which occurs as the river flows downstream it create a lot of impacts on the river banks through erosion and the other sources of pollution is the agricultural activities.

4.4.4 Level of pollution of the River

The respondents were further asked to rate the level of degradation of the river. This was because the researcher was interested to know how the residents value the water and other resources found in the river. Finding are presented in the table 4.12

Table 4.12; Level of pollution

Level of pollution	Frequency	Percent
Very High	103	29
High	100	27
Low	106	30
Very Low	17	5
None	33	9
Total	**359**	**100**

The leading percentage at 30% of the respondents said that pollution is low which may mean that there is no serious damage on the river but combining the other two levels of respondents who responded that it is very high and high at 29% and 27% respectively will mean that the level of pollution is high and something must be done to reverse the effect, 9% of the population said the river is not polluted, and 5% of the respondents rated degradation as very low.

4.5 Economic Implication of River Degradation

In evaluating economic implication of Moiben River degradation, the researcher wanted to know water protection responsibility, the quality of water found in the river and current river protection.

4.5.1 Water Protection Responsibility

The researcher sought information on water protection responsibility and the findings are as follows

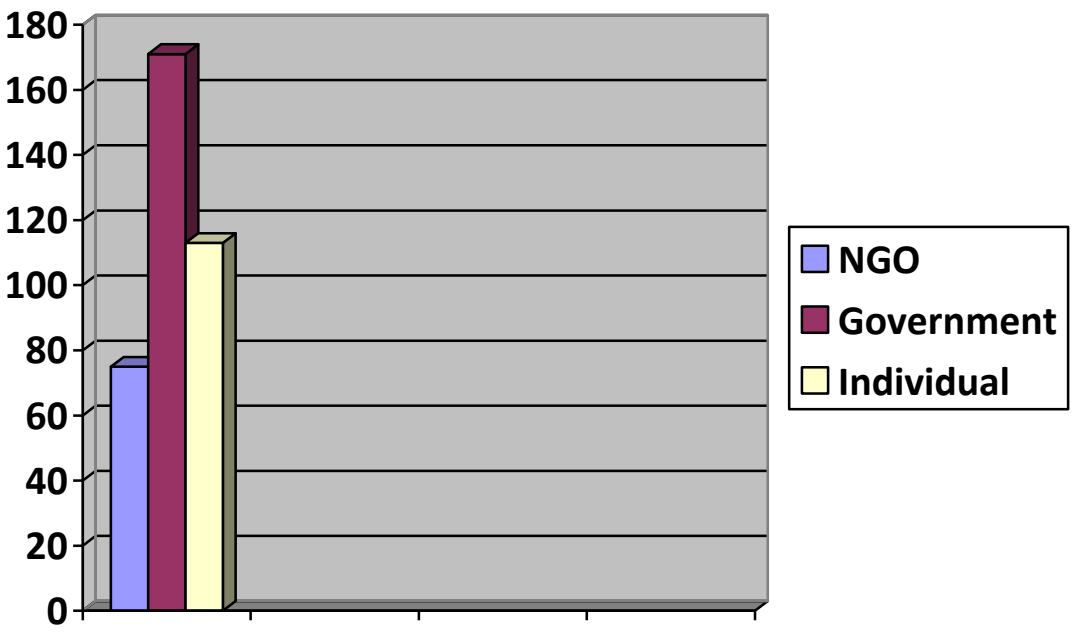

Figure 4: Water Protection Responsibility

Respondents who recorded highest percentage at 48% are those who believe Government to be responsible with the protection of the river which may mean that most members of the society are not aware of their role in environmental protection. The second highest percentage is from those who said that individuals are responsible at 31% which mean that some of the

populations know their role in protecting the environment/river resource. The last group of the respondents 21% said Non Governmental Organizations should protect the river.

4.5.2 Quality of the Water

For the researcher to get more information and different diverse views about the water quality of the river, different respondents were interviewed. Table 4.13 below shows the findings from the study

Table 4.13 Quality of the water

Views	Frequency	Percent
Very Good	55	15
Good	124	35
Satisfactory	112	31
Poor	43	12
V poor	20	7
Total	**359**	**100**

From table 4.13, results from the findings show that 35% of the respondents stated water quality to be good and 31% of the respondent reported satisfactory results. This indicates that water quality is in good quality and can be used for both industrial and domestic uses with minimum treatment, 15% of the respondents said that water from the river is very good. From the findings 12% said the quality of water is poor and finally 7% said water from the river is

very poor, putting the two together gives 19% which is a big percentage showing that the quality is wanting and something needs to be done. Respondents gave different response which indicate their understanding on the quality of the river, their different activities, distance from the river and age could be a factor in their response.

4.5.3 Current Protection of the River

In order to know how the residents value the river, they were told to rank the current protection of the river resources. The findings were thereafter analyzed and the results were as follows

Table 4.14; Current River Protection

Current River Protection	Frequency	Percent
Very Good	49	14
Good	91	25
Satisfactory	144	40
Poor	57	16
Very Poor	18	5
Total	359	100

The study findings as shown in the table 4.14 revealed that 40% ranked satisfactory protection meaning that the river is under threat of pollution, 25% ranked protection good which showing that people appreciate the current state. 14% of the respondents ranked the

current river protection very high, whereas, 16% ranked poor and finally 5% ranked very poor. The current river protection from the study finding is satisfactory. In general the river is under threat and needs action towards protecting it.

4.6 The Results of Contingent valuation Model and Willingness To Pay

4.6.1. Willingness To Pay Response

Those who were willing to pay for improved water protection were 289 respondents. This represented 80% of the sampled population, while 20% of the same populations were not willing to pay. Respondents 32 out of 70 who were not willing to pay said the project is too expensive and the government should take control of it. The rest were not ready to participate on the project saying it will be corrupted by the national or the county government; some gave an example of the current Lake Victoria Water Project saying its source is Moiben River and none of the resident is employed.

Table 4.15: Willingness to Pay

Bids (Amount Kshs.)	**Median (bids Amount Kshs.)**	**Frequency**	**Percent**	
Non response	0	70	19	0
Below 100	50	93	26	4650
101-200	150	100	27	15000
201-300	250	63	18	15750
301-400	350	17	5	5950
401-500	450	10	3	4500
Above 501	550	6	2	3300
Total		**359**	**100**	**49150**

The highest percentage of 27% of the respondents responded that they were willing to pay a bid of Kshs 150 monthly for river protection citing that water is crucial in their day to day activities. They gave the example of water used for horticultural farming off rainy season, water for cooking and watering livestock as the main cause why they were willing to pay. Those who bidded Ksh. 50 were 26%, 19% were not willing to put any price for they said that water is free and others were not satisfied with the leadership. Those willing to bid Ksh. 250 was 18%, those WTP a bid of Ksh. 350 were 5% whereas 2% were WTP a bid of Ksh. Ksh. 450 finally 5% were willing to give a bid of Ksh. 500. The average amount the residents

are willing to pay for river protection is Ksh170. The willingness to pay indicates that the community is willing to protect the natural resource and that they attach value to the river.

4.6.2 Improved Domestic Water Supply

The researcher further asked the respondents if they were willing to pay extra monthly charges for the improved domestic water supply. Most of them gave a value between Ksh.1-100

Table 4.16: Domestic Water Supply

Bids(Amount Kshs)	Midian (amount ksh)	Frequency	Percent	Total
Bellow 100	50	121	34	6050
101-200	150	91	25	13650
201-300	250	66	18	16500
301-400	350	41	12	14350
401-500	450	21	6	9450
Above 501	550	19	5	10450
Total		**359**	**100**	**70450**

The study findings reveal that, 34% of the respondents willingly agreed an addition of Kshs. 1-100 monthly extra charges for domestic water supply, 25%gave a value between 101-200, 18% gave a value of Kshs 201-300, 11% said a value between 301-400, 6% said were willing

to pay 401-500 and 5% respondents were willing to pay a value above Kshs 501. Moiben residents are willing to pay an average of ksh196 per month for water supply. Most people of this region are willing to pay any amount below ksh 200 for domestic water supply. Therefore the County Government need to extend water provision services to the region with a fee.

4.6.3 Relationship between Willingness to pay and estimation model

Table 4.17: ANOVA

ANOVA was carried out. The significance level was set at 95% with and α=0.05.The test statistics are summarized in table 4:17 below: this was to determine the factor that is significant to the willingness to pay.

Model	**coefficients**	**S.E**	**t**	**Sig.**
Constant	-	.127	8.089	.000
Age	0.006	0.018	.107	.915
Gender	0.056	0.043	1.050	.295
marital status	-0.060	0.034	-1.096	.274
level of education	-0.052	0.024	-.954	.341
Employment	0.128	0.024	.749	.454
Household size	0.114	0.023	2.220	. 027
Land size	0.030	0.021	.560	.576
Monthly income	0.037	0.023	.691	.490
Distance to the river	0.012	0.020	.225	.822

a. Dependent Variable: WTP

Based on the results there was significant relationship positive between household size (2.220) and WTP as determined by ANOVA. Gender (1.050), employment (0.749) and

monthly income (0.691) were positively related to WTP but not significant. Age (.107) and distance from the river (.225) were positively relate to WTP and though not significant.

Table 4.18: ANOVA

Furthermore ANOVA was carried out. The significance level was set at 95% with and α=0.05.The test statistics are summarized in table 4:18 below:

Variables		**Sum of Square**	**Df**	**Mean Squar**	**F**	**Sig.**
Economic Significance of Moiben River to the Household	Between Groups	.363	1	.363	1.495	.223
	Within Groups	55.398	228	.243		
	Total	55.761	229			
Effects of Agricultural Productivity on Degradation of the River	Between Groups	.255	1	.255	1.034	.310
	Within Groups	56.267	228	.247		
	Total	56.522	229			
Economic Implication of River Degradation	Between Groups	.002	1	.002	.006	.936
	Within Groups	56.646	228	.248		
	Total	56.648	229			
Economic Value of Improved Management of the River	Between Groups	.000	1	.000	.001	.982
	Within Groups	55.930	228	.245		
	Total	55.930	229			.223

Based on the results in the table 4.18 above, it is clear that there was no statistically significant difference between groups as determined by ANOVA (F(1,228) = 1.495, p = 0.223). The significance level is 0.223 (p =0.223), which is above 0.05 and, therefore, there is no statistically significant difference in the mean response of the economic significance of Moiben River and the household. In conclusion basing on the findings from the respondents, the economic significance of Moiben River has no effect on the households.

Moreover, the results show that there was no statistically significant difference between groups as determined by ANOVA ($F(1,228) = 1.034$, $p = 0.310$). The significance level is 0.310 ($p = 0.310$) which is above 0.05 and, therefore, there is no statistically significant difference in the mean response of the effects of agricultural productivity and degradation of the river. We therefore conclude based on the findings of the response that agricultural productivity has no effect on the degradation of the river. This may mean that agricultural activities are not the key factors responsible with the river degradation.

On the other hand, the results show that there was no statistically significant difference between groups as determined by ANOVA ($F (1,228) = 0.006$, $p = 0.936$). We can see that the significance level is 0.936 ($p = 0.936$) which is above 0.05 and, therefore, there is no statistically significant difference in the mean response of the economic implication and river degradation. It can therefore be conclude based on the findings of the response that economic implication has no effect on the degradation of the river.

Finally, the results show that there was no statistically significant difference between groups as determined by ANOVA ($F(1,228) = 0.001$, $p = 0.982$).Therefore the significance level is 0.982 ($p = 0.982$) which is above 0.05 and, thus there is no statistically significant difference in the mean response of the economic value and improved management of the river. It can therefore be concluded based on the findings of the response that economic value has no effect on improved management of the river.

4.7 Regression Model

4.7.1 Correlation matrix between WTP and independent variables

As indicated earlier that WTP is the dependent variable and the independent variables were age, gender, marital status, education level, employment, household size, land size, monthly income, and distance from the river. Correlation between WTP and the independent variables were necessary to be done; this was to find out the relationship between the WTP and the independent variables and within the independent variables and the direction it takes.

Table 4.19: Pearson Correlation Coefficients

Pearson Correlation Coefficients

		AGE	G	MS	EDL	EM	HHS	LS	MI	RD	WTP
AGE	PC	1	-069	.220**	-.062	.074	.361	-.049	-.035	.061	.039
	Sig.		.195	.000	.244	.160	.000	.355	.507	.251	.456
G	PC	-.069	1	.065	.101	.067	-.032	-.023	.005	.053	.045
	Sig.	.195		.221	.055	.202	.544	.658	.920	.318	.391
MS	PC	.220**	.065	1	-.071	.055	.116*	.015	-.020	-.023	-.035
	Sig.	.000	.221		.182	.295	.027	.780	.705	.667	.513
EDL	PC	-.062	.101	-.071	1	.111*	.059	.058	.146**	.131*	-.022
	Sig.	.244	.055	.182		.036	.266	.270	.006	.013	.676
EM	PC	.074	.067	.055	.111*	1	-.026	.013	.041	-.081	.033
	Sig.	.160	.202	.295	.036		.629	.805	.440	.126	.531
HHS	PC	.361	-.032	.116*	.059	-.026	1	-.017	.103	.082	.121*
	Sig.	.000	.544	.027	.266	.629		.746	.052	.121	.021
LS	PC	-.049	-023	.015	.058	.013	-.017	1	.037	-.026	.024
	Sig.	.355	.658	.780	.270	.805	.746	.182	.482	.618	.657
MI	PC	-.035	.005	-.020	.146**	.041	.103	.037	1	-.011	.047
	Sig.	.507	.920	.705	.006	.440	.052	.482		.830	.379
RD	PC	.061	.053	-.023	.131*	-.081	.082	-.026	-.011	1	.005
	Sig.	.251	.319	.667	.013	.126	.121	.618	.830		.667
WTP	PC	.039	.045	-.035	-.022	.033	.121*	.024	.047	.016	1
	Sig.	.456	.391	.513	.676	.513	.021	.657	.379	.763	

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

PC - Pearson Correlation

Sig. - Sig. (2-tailed)

G- gender, MS- marital status; EDL- education level; EML- employment; HHS- household size; LS- land size; MI- monthly income; RD- distance from the river; WTP- willingness to pay.

In determining the relationships using Pearson correlation at 0.01 2 - tailed significant; age was negatively related to education -0.062; land size -0.049 and income -0.035. Positively related to marital status 0.220; household size 0.361; distance to the river 0.061. The young are more educated than the old, the young own smaller pieces of land, the income increase with age and it can be reported that the household size increase with age. Gender is positively related to education 0.101; low related and positive to marital status 0.06; employment 0.067; income 0.005 and distance to the river 0.053. This means that women are more learned to men, more women are married to men.

Marital status was positively correlated to employment 0.055; household size 0.116*and land size 0.015. Negatively related to income -0.020; distance to the river -0.023; education -0.071; Education is positively correlated to income 0.146**; employment 0.111 and distance from the river 0.131. Employment is positive and low related to land size 0.013 and income 0.041; while negatively related to household size -0.026 and distance to the river -0.081. Household size is positively related to income 0.103 and distance from the river 0.082. It is negatively related land size -0.017. Land size is positively related to income 0.037 and negatively related to distance from the river-0.011.

CHAPTER FIVE

DISCUSSIONS

5.0 Introductions

This chapter seeks to discuss the findings of the research.

5.1 Response Rate

The researcher issued 384 questionnaires but 359 of the total questionnaires were filled and returned

5.2 Demographic Information

Majority of the respondents were male showing that the study captured more male than female. The research incorporated both genders in the study so as to avoid gender biasness. Male respondents were the majority because of the socio-cultural structure of the community which considers a man as the head of the family.

Majority of the respondents were aged between 18-27 years hence they were young and energetic ready to work in the area though the researcher sought to establish answers from different age groups so as to avoid age biasness across different age groups. This finding is in agreement with the County CIDP which indicates that the population increase downwards, the old being the minority. This therefore calls for investment in economic and social facilities such as health services, education, ICT, agriculture, livestock among others to provide both food and employment opportunities. Majority of the respondents were secondary school leavers showing that majority have basic knowledge; the aim was to find out how conversant the respondents were about economical valuation of river degradation.

The results reveal that most of the respondents engage on agriculture, which are mainly; crop farming and livestock rearing. The farming activities include maize, beans, vegetable and millet plantation. Livestock rearing include cows, sheep, goats and hens. Most of the residents engage in small scale farming. From the research findings the area is densely populated because majority of the household had 4-6 members, therefore this is expected to cause an impact on the river, this is because of their daily activities which include domestic, agricultural, industrial and some commercial. Most of the respondents earn below 10,000 shillings, this was expected to affect willingness to pay for the natural resource negatively but this was not the case since that income was not significant in this study as the case was with other researchers. Walton, (2015) in his study noted payment to be affected by the economic capacity of individual family where the higher the income the more willing to pay.

5.2.1 Economic Significance of Moiben River to the Household

Majority of the respondents owns below 10 acres while minority owns 41 and above acres. Most of the respondents captured were living 1 km and below from the river hence having high benefits from the river. Majority of the residents use the river for domestic purposes. Moiben river has played a fundamental role in the lives of the people of Marakwet West and Moiben Sub County. These waterways provide water for irrigation, potable water and to some extent fish stocks supporting thousands of livelihoods. Water from the rivers is a basic natural resource, essential for various human activities.

5.2.2 Effects of Agricultural Productivity on Degradation of the River

Majority of the respondents rate resource use as satisfactory hence have no serious harm on the river. Most of the respondents use river for household purpose, of the total sampled

population people gave the following as the cause of river polluted: agricultural products, natural, industrial, and domestic in that order. Majority of the respondents show that the level of degradation in the river is low hence does not affect much on the river resources. Though agriculture is rated low, cutting trees for timber (industrial) contribute to soil erosion making it the main sources of water pollution as indicated by Cheboywo in his studies (Cheboiwo 2012). Several scholars including the studies of Kibichii et al., (2007) and Kasangaki et al., are agree that land use has a negative impact on natural resource

Everyday agricultural activities have a huge impact on the amount of nutrients and pesticides reaching watercourses. Spraying, muck spreading, field cultivation, machinery movement and field drainage all contribute to how much sediment, nitrate, phosphate and faecal matter enters rivers and streams. However, it is often simple and cheap to address any problems and help improve water quality and the profitability of the farm. Producing food involves many activities and practices that can affect the quality of water resources under and near the field. For example, tilling the soil and leaving it without plant cover for extended periods of time can accelerate soil erosion. County government in their CIDP identified agriculture as the main source of income and as the cause of degradation. Also to the study done by Kibichii et al., (2007, Mathooko, (2001) Raburu et al., (2009) done in other places are in support that anthropogenic activities pose a lot of influence on stream habitat and biotic life as found by

5.2.3 Economic Implication of River Degradation

The findings show that it is the responsibility of the government to protect the river. The current river protection from the study finding is satisfactory.

5.2.4 Estimating WTP and factors that influences likelihood of WTP response.

The researcher further asked the respondents if they were willing to pay extra monthly charges for the improved domestic water supply. They were willing to pay Ksh. 170 for river protection and Ksh. 196 for improved domestic water supply. Based on the results above, it can be seen that there was no statistically significant between WTP and age, gender, marital status, education, employment, land size, monthly income and distance from the river.

Moreover, the results show that there was statistically significant between household size and WTP. this agree with the studies done by Carlsson and Martinsson (2007) who discovered household size to be having a positive effect on WTP as this study. Whereas other scholars like Munisinghe et al,(1993), Choe et al (1994), Mcconnel(1997), and Wasike (1996) that income had a positive significant on WTP. Hament et al, (2001) in his study found that education level of respondents had a positive and significant effect on WTP.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the conclusions and some suggested recommendations of the study based on the data collected and analyzed and future studies

6.1 Conclusion

Having analyzed the data and the findings the researcher came up with the following Conclusions as: Moiben River has played a fundamental role in the lives of the people of Marakwet West and Moiben Sub County. These waterways provide water for irrigation, potable water and to some extent fish stocks supporting thousands of livelihoods. Water from the rivers is a basic natural resource, essential for various human activities. From the findings, the community attaches value to Moiben river. The residents s are willing to pay(Ksh.170) for Moiben river protection and Ksh.196 extra for improved domestic water supply

Based on the results, we could conclude that there was no meaningful significance between WTP and age, gender, marital status, education, employment, land size, monthly income and distance from the river as determined by ANOVA. Moreover, the results show that there was clear significance between household size and WTP as determined by ANOVA

6.2.1 Recommendation

Due to the increased industrial related activities, there is likelihood of the increase in the nutrients in the rivers. Therefore, this study recommends that residents be sensitized on

environmental protection to adequately address any potential environmental problems associated to water pollution and help improve water quality and the profitability of the farm.

Since that the residents are willing to pay for improved domestic water supply, the Government need to provide treated piped water.

6.2.2 Suggestion for further studies

It is proposed that future studies be done in the same area with a wider scope to include more institutions that benefit from the water source and the GIS of the landscape showing the extent of destruction. This will help in determining in-depth WTP. It is important to know how resources are used within the locality and those who benefit far away from the source.

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APPENDIX I: QUESTIONNAIRE

Economic Valuation of Moiben River Degradation and Domestic Water Supply in Elgeyo/Marakwet County, Kenya

Instruction

Good morning/afternoon. My name is John Kipyegon Kiprop a master's student of University of Eldoret. I am on an academic research on the economic valuation of river Moiben. I would appreciate if you give part of your time. The information you give is purely for academic purposes and would be treated with confidentially. Thanks

INTERVIEW NFORMATION

1. Respondents' Location
    a) Sub-county……
    b) Sub-location……..
    c) Village……..
2. Interview date _____-

SECTION A: BACKGROUND INFORMATION

Please complete the following questions as appropriate as possible

Socio-economic information

1. What is your Gender? 1. Male [ ],2. Female [ ]
2. What is your Marital Status? 1. Single [ ], 2.Married [ ], 3.Divorced [ ], 4.Separated [ ]

3. What is your age in years? 1. 18-28 yrs[ ], 2.29-39 yrs[ ], 3.40-50 yrs[ ], 4. 51-60 yrs[ ] , 5. 61 and above yrs[ ].
4. Which is your highest level of education? 1. Primary [ ], 2.Secondary [ ], 3.College [ ], 4.University [ ] 5.post graduate[ ]
5. Which occupation do you belong? 1. Unemployed [ ], 2.business [ ], 3. Farmer [ ], 4.civil servant [ ], 5. Any other specify……
6. What is the size of your household? 1.1-3[ ], 2.4-6[ ], 3.7-9[ ], 4.above 10.[ ].
7. What is the size of your land? [In acres] 1.0-10[ ], 2.11-20[ ], 3.21-30[ ], 4.31-40[ ], 5. 41 and above [ ].
8. On average what is the monthly income in Ksh. earned by all people in your household? 1. Below 5000/= [ ], 2. 6000/=-10000/= [ ], 3. 11000/=-15000/= [ ], 4. 16000/=-20000/= [ ], 5. 21000/=-30000/= [ ], 6. 31000/=-40000/= [ ], 7. 40000/=-50000/= [ ], 8. Above 50000/= [ ].
9. How far is the river from where your farm? [In kilometers]. 1. 1 and Bellow [ ], 2. 2 [ ], 3. 3[ ], 4. 4[ ], 5. 5 and above[ ],

Water supply, quality, quantity

10. How would you rank the quality of water in the river? 1. Very good [ ], 2. good [ ], 4.satisfactory[ ], 5.poor[ ], 6.very poor[ ].

River use, pollution and protection of the river

11. Are there any other resources found in Moiben river apart from water? 1. Yes[ ], 2.no[ ].If yes to the question 11 above name them……..
12. How do you use the resources found in Moiben river? 1. Domestic [ ], 2. Commercial [ ], 4.none of the above [ ].

13. In your own opinion how could you describe the rate at which the resources found in Moiben river are used? 1. Seriously over used [ ], 2.over used [ ], 3. Satisfactory [ ], 4.under used [ ], 5. Seriously under used [ ].

14. Do you practice agriculture farming? Yes [ ], no [ ]. If yes, fill the table below

Farming activity	**Size/ number**	**Amount of fertilizers used**	**Annually income**
a. Crops			
1.			
2.			
3.			
4.			
b. livestock			
1.			
2.			
3.			
4.			

15. Is there any relationship between fertilizer application and crop yield? 1.Yes[ ],2.No[]

16. Do you practice any soil conservation measures with your household? 1. Yes [ ], 2.No [].

17. If yes, which of the following do you and your household practice in your farm?

    1. Terracing [ ], 2. Contour farming [ ], 3.Tree planting [ ], 4.Crop rotation [ ], 5. None [ ]

18. What are the other uses of river besides agriculture? 1. Household use ( ), 2. School supply ( ), 3. Industrial use ( ), 4. Municipal use [ ], 5. Other? Specify

19. In case the government today decides to use the river for other function will you have any other source of water? 1. Yes [ ], 2. No [ ].

20. Who among the following does the role of protecting the river resources? 1. NGO [ ], 2.Government [ ], 3.individuals, 4. None [ ].
21. Are there any training given to you on the right use and conservation of the river? 1. Yes [ ], 2.no [ ].
22. In your own opinion what are the sources of degradation to this river? 1. Natural [ ], 2.industrial [ ], 3.domestic [ ], 4.agriculture [ ], 5.all of the above [ ], 6. None [ ].
23. What is the level of degradation? 1. None [ ], 2.v.high [ ], 3. High [ ], 4. Low [ ], 5.v. Low [ ].
24. Do you think the local community participates well on protecting the river from degradation? 1. Yes [ ], 2. No [ ].
25. If your answer is yes what are the reasons? .....
26. Is it important to protect the river from degradation and degradation? 1. Yes [ ], 2.no[ ].

If your answer is yes, give reasons…….

27. Rank the current protection of the river resource. 1. Very good [ ], 2.good [ ], 3.satisfactory [ ], 4.poor [ ], 5.very poor [ ].

Economic valuation of river degradation and water supply

With farming activities taking place, the river is expected to be subjected to degradation from farming chemicals and soil erosion. Suppose you are given the opportunity to form river protection committee under a new management of ‘Moiben community water service’ for reduced degradation of Moiben river. All community members have equal say to the project management. For this project to succeed you are expected to pay a monthly fee. The fees paid will be used on the payment of the staff, guards, planting trees, patrols

1. With the information given above, assume that the river is under threat to degradation, would you be willing to pay for its improved protection? 1. Yes/2.no
2. If your answer is no, why? 1. Don't want to participate [ ], 2. river has no value[ ], 3.not aware[ ], 4.too expensive[ ].
3. If yes, what is the maximum you are willing to pay per month?.....
4. Further, in order to improve domestic water supply in your household, are you willing to contribute extra money above the indicated above? 1.Yes [ ] /2. No [ ] ----------
5. If No give reasons 1.Don't want to participate [ ], 2. river has no value[ ], 3.not aware[ ], 4.too expensive[ ].
6. If Yes, how much are you willing to pay per month……..

Thank you for your cooperation and participation in the study.